This draft, August 2000, prepared by the Office of Worker Protection Policy and Programs, has not been approved and is subject to modification. Project No. SAFT-0073

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DOE-HDBK-XXXX/1-2000
PROPOSED

DOE HANDBOOK

CHEMICAL MANAGEMENT
(Volume 1 of 2)

U.S. Department of Energy
Washington, D.C. 20585

AREA SAFT

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Foreword

DOE
ISM

This non-mandatory Handbook is designed to assist Department of Energy (DOE) and contractor managers in assessing chemical hazard management. Examples of best practices and real life examples needed to institute high-quality chemical management within the context of a site's Integrated Safety Management System (ISMS) are provided.

DOE P 450.4
DEAR

DOE Policy 450.4, "Safety Management System Policy," and Chapter 9 of Title 48 of the Code of Federal Regulations (CFR), Department of Energy Acquisition Regulation (DEAR), call for systematic integration of safety into management and work practice at all facets of work planning and execution. Material acquisition, handling, and final disposition are some of the key components of management systems to which the Integrated Safety Management (ISM) Core Functions are applied. Consideration of environment, safety, and health risks for these components is, in principle the same for all hazards, whether chemical, radiological, or physical. Therefore, a quality chemical management program is merely part of a site's ISMS and need not call for new or additional requirements.

This Handbook is comprised of two Volumes. Volume 1 contains the core material. Chapter 1 presents a discussion of how chemical management fits into ISM. The ISM Core Functions (Define the Scope of Work, Analyze the Hazards, Develop and Implement Hazard Controls, Perform Work within Controls, and Provide Feedback and Continuous Improvement) provide the structure needed to ensure all work activity is undertaken safely.

OSHA
EPA
DOE-STD-3009-94
DOE O 440.1A

A number of DOE, Occupational Safety and Health Administration (OSHA), and Environmental Protection Agency (EPA) directives, standards, and requirements address chemical management both directly and indirectly. DOE examples include DOE-STD-3009-94, "Preparation Guide for U.S. Department of Energy Nonreactor Nuclear Facility Safety Analysis Reports," and DOE Order 440.1A, "Worker Protection Management for DOE Federal and Contractor Employees." Chapter 2 discusses the elements of a quality chemical management program. The elements are presented in a logical sequence and each section includes information on applicable DOE, OSHA, and EPA directives, standards, and requirements.

The Appendices to Volume 1 contain sample lines of inquiry which may be used for ISM verification, lessons learned to allow readers an opportunity to learn from the experiences of their peers, and a listing of program resources.

ACC
Responsible Care

Supplemental to the core Handbook, Volume 2 presents site approaches to chemical management programs from across the DOE complex and the chemical industry to illustrate chemical management program implementation. For example, the American Chemistry Council's (ACC) Responsible Care ® program has been found to be a useful tool in chemical

MSV pilot

management at a recent Management System Verification (MSV) pilot project at the Hanford Plutonium Finishing Plant (PFP).

The Handbook is designed to serve as a general reference for chemical management. It is formatted to allow quick and easy access to its content and useful references. For example, the oversized left margin contains annotations to key points presented in the text. In addition, in the electronic version, these annotations are active links which allow navigation to web sites for more detailed information on specific topics. An expanded version of this document with the most recent collection of best practices and lessons learned will be maintained on the DOE Chemical Management Web Site at http://www.eh.doe.gov/web/chem_safety/.

EH-5 Chemical Management Web site

We invite everyone to share their experiences by submitting exemplary chemical management practices or lessons learned via our Web Site Feedback page at http://www.eh.doe.gov/web/chem_safety/.

Feedback

Table of Contents

Acronyms and Abbreviations

ACC	American Chemistry Council
ACGIH	American Conference of Governmental Industrial Hygienists
ACIS	Automated Chemical Inventory System
CGA	Compressed Gas Association
ANL	Argonne National Laboratory
ATSDR	Agency for Toxic Substances and Disease Registry
BHI	Bechtel Hanford Incorporated
BNL	Brookhaven National Laboratory
CAMEO	Computer Aided Management of Emergency Operations
CAS	Chemical Abstract Service
CAT	Consolidated Annual Training
CC	Chemical Coordinator
CCMC	Chemical Commodity Management Center
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CGITS	Cradle-to-Grave Information and Tracking System
CHEMTREC	Chemical Transportation Emergency Center
CID	Chemical Inventory Database
CIS	Chemical Inventory System
CMP	Chemical Management Program
CMS	Chemical Management System
CO2	Carbon Dioxide
CQC	Controlled Quantity Chemical
CSTC	Chemical Safety Topical Committee
CTS	Chemical Tracking System
DEAR	Department of Energy Acquisition Regulation
DOE	Department of Energy
DOT	Department of Transportation
EM	DOE Office of Environmental Management
EM&R	Emergency Management and Response
EMO	Emergency Management Organization
EPA	Environmental Protection Agency
EPCRA	Emergency Planning and Community Right-to-Know
ES&H	Environment, Safety and Health
ESH	Environment, Safety and Health Division
EWP	Enhanced Work Planning
FEMA	Federal Emergency Management Agency
FEMIS	Federal Emergency Management Information System
GET	General Employee Training
HazComm	Hazard Communication
HAZMAT	Hazardous Materials
HEPA	High Efficiency Particulate Air
HF	Hydrogen Fluoride
HMIS	Hazardous Materials Information System

HAZWOPER	Hazardous Waste Operations and Emergency Response
ICMS	INEEL Chemical Management System
INEEL	Idaho National Engineering and Environmental Laboratory
IOPS	Integrated Operations System
ISM	Integrated Safety Management
ISMS	Integrated Safety Management System
ISO	International Organization for Standardization
JIT	Just-In-Time
LDR	Land Disposal Restriction
LOI	Lines of Inquiry
MARPLOT	Mapping Applications for Response and Planning of Local Operational Tasks
MIN	Materials In Inventory
MSDS	Material Safety Data Sheet
MSV	Management System Verification
NaK	Sodium Potassium
NETO	National Environmental Training Office
NFPA	National Fire Protection Association
NSC	National Safety Council
OE	Operating Experience
ORNL	Oak Ridge National Laboratory
ORPS	Occurrence Reporting and Processing System
OSHA	Occupational Safety and Health Administration
PEL	Permissible Exposure Limit
PFP	Plutonium Finishing Plant
PHR	Process Hazard Review
PNNL	Pacific Northwest National Laboratory
RCRA	Resource Conservation and Recovery Act
RMP	Risk Management Plan
RQ	Reportable Quantity
SAR	Safety Analysis Report
SARA	Superfund Amendments and Reauthorization Act
SBMS	Standards-Based Management System
SME	Subject Matter Expert
SNL	Sandia National Laboratory
S/RIDs	Standards/Requirements Identification Documents
SRS	Savannah River Site
SWITS	Solid Waste Information Tracking System
TLV	Threshold Limit Value
TQ	Threshold Quantity
TRI	Toxic Release Inventory
UBC	Uniform Building Code
UFC	Uniform Fire Code
VPP	Voluntary Protection Program
WSMS	Westinghouse Safety Management Solutions
WSRC	Westinghouse Savannah River Company
WSS	Work Smart Standards

Introduction and Scope

Why a DOE Chemical Management Handbook?

DOE

Chemicals are ubiquitous in DOE's nuclear and non-nuclear operations. Given their wide application, it is not surprising that chemical incidents or exposures continue at a rate of approximately one a day. With respect to major accidents, chemicals are the second leading cause of DOE Type A & B accidents, exceeded only by those attributed to radiation.

All chemical exposures have the potential for health consequences. Depending on the toxicology and concentration, the effects of chemical exposures may be immediate (acid burns) or long term (chronic beryllium disease or cancer). In any case, chemical exposures may result in life threatening outcomes. Chemicals may cause physical damage such as explosions or fires resulting in serious injury and facility damage. Facility and mission related effects might include corrosive actions that degrade equipment performance (like mercury on copper nickel alloys and aluminum) and residual contamination that limits the future use of facilities and equipment. Environmental issues may arise as a result of spills, releases, or waste chemical inventories. In addition to the health effects, physical damage, or environmental effects that may result from a chemical incident, there will be a need to apply scarce resources to the mitigation of the incident.

Chemical Vulnerability Working Group Report

Management Response Plan

Despite the 1994 Chemical Vulnerability Study and the management response plan developed to address its findings, the chemical incident rate to date at DOE has remained essentially unchanged. To effectively reduce both the number and magnitude of incidents, DOE needs to effectively use its safety resources to raise the awareness of chemical hazards and improve chemical safety management. These resources include expanded use of chemical management best practices, lessons learned, and existing guidance.

There are numerous DOE, OSHA, and EPA standards, rules, orders, etc., which contain chemical management requirements as well as lessons learned (Appendix B) and best practices. Field operations need to ensure chemical management is fully incorporated into ISM programs, consolidate these requirements and best practices, and avoid duplication to focus on what is truly essential. This Handbook will provide guidance and examples, such as successes in integrating chemical management into existing ISM programs.

Use of the guidance, best practices, and lessons learned contained in this Handbook will result in safer operations, greater productivity, and a reduced need for costly interruptions to operations.

1.0 Chemical Management as part of Integrated Safety Management

DOE P 450.4 (ISM)

This chapter presents a discussion of the five ISM core functions from the perspective of chemical management. To accomplish work safely and protect workers, the public, and the environment, the safety system functions to identify hazards and establish controls. These hazards range from commonly encountered workplace hazards to one-of-a-kind process hazards found in existing newly designed to old, non-operational facilities. For personnel who plan tasks involving chemicals, the goal is to ensure that safety documentation for the facility, procedures for conducting the task, and supporting hazard identification and analysis adequately address the full range and scope of chemical hazard(s).

1.1 Define the Scope of Work

Translating a mission into work is the first step to planning and accomplishing work tasks safely and effectively. Planning considers the entire life cycle of a mission, and as such, the entire life cycle of chemicals required to accomplish the work must also be considered.

Defining expectations for the scope of work addresses the goals and objectives for both DOE and the contractor to accomplish the work. At this step in planning, issues relating to chemicals that could be considered include efficacy versus toxicity, engineering controls, chemical disposal, emergency response, medical monitoring, or release to the environment. The impact of these issues should be weighed against performance expectations and resolved to support the mission and the allocation of resources.

If a site's mission involves the use of chemicals, then some of the contractual requirements address chemical management, i.e., chemicals used to accomplish work, chemicals in storage or transportation, or chemicals as waste materials.

When a change in the scope of work, or in requirements or regulations affects a site's chemical management, the sufficiency of the set of contractual chemical management requirements must be evaluated. As a mission matures and the work moves from one phase to another, incorporates evolving technologies, or adjusts to changes in prioritization and budget, the set of contractual requirements for chemical management should be continuously evaluated as a part of the ISM self-assessment process. DOE G 450.3-3, "Tailoring for Integrated Safety Management Applications," can be used to guide the review and evaluation of work controls for managing chemicals.

DOE G 450.3-3

1.2 Analyze the Hazards

DOE G 450.4-1A

29 CFR 1910.1200, Hazard Communication
EPA
RCRA

Hazards from chemicals are identified, analyzed, and categorized prior to work being performed. A "hazard" is defined by DOE G 450.4-1A as a source of danger (i.e., material, energy source, or operation) with the potential to cause illness, injury, or death to personnel or damage to a facility or the environment (without regard to the likelihood or credibility of accident scenarios or consequence mitigation). OSHA's Hazard Communication Standard (29 CFR 1910.1200) defines a hazardous chemical as any chemical that poses a physical or health hazard. EPA defines hazardous wastes in 40 CFR 240-299 [(implementing regulations for the Resource Conservation and Recovery Act (RCRA)].

Use of an integrated approach to hazard analysis will result in effectively identifying site and facility hazards, including chemical hazards and the hazards associated with the disposal of the hazardous chemicals. Analysis can begin at these levels by assessing chemicals present in quantities greater than the Threshold Quantities (TQ) or Reportable Quantities (RQ). These materials are generally analyzed from the process safety perspective, i.e., potential for a catastrophic accident with immediate consequences.

Information from these hazard analyses can then be used as the basis for more detailed analysis at the activity or task level. At this level, hazards associated with a worker's exposure to chemicals, as a result of their daily activities, are assessed.

1.3 Develop and Implement Hazard Controls

Safety standards and requirements are identified and appropriate controls are developed using the information obtained from the hazard analysis and prior to work being performed.

S/RIDs
Authorization Bases

Work Smart Standards (WSS)

The identification of standards, requirements, and work controls that are applicable to the entire life cycle of the work help ensure that the work is accomplished safely. This process is undertaken using the Standards/Requirements Identification Documents (S/RIDs), Work Smart Standards (WSS), or a similar process to ascertain which standards, requirements, and work controls should be included in contracts.

DEAR

For hazards that have been included in the site-wide analyses, Lists A and B at DEAR 48 CFR 970.5204-78(a) and (b) identify the applicable standards and requirements *[List A consists of the required applicable Federal, State, and local laws and regulations (including DOE regulations), while List B contains the identified DOE directives appended to the contract]*. However, as a result of facility and activity level hazard analysis, new chemical hazards may be identified. These newly identified hazards may evoke standards not identified earlier in this process.

Based on the identified hazards and standards set, controls are developed to ensure safe operating conditions. The control of chemical hazards is, in general, no different than controlling other hazards, i.e., radiological hazards. An integrated process to identify and apply the hierarchy of controls (engineering, administrative, and personal protective equipment), including pollution prevention/waste minimization options, on the work is in place as part of the site's ISMS.

A multi-disciplinary hazard analysis team comprised of line management, health and safety professionals, and workers can effectively tailor the controls applied to the work at the facility and site level.

DOE-STD-3009-94

DOE-STD-3009 provides guidance for nuclear facilities on establishing documented safety limits, limiting control settings, and limiting conditions for operation, surveillance requirements, administrative controls, and design features that result from a disciplined safety analysis. However, this standard does not address common industrial hazards that make up a large portion of basic OSHA regulatory compliance (DOE-STD-3009, Sections 3.3.1.1 and 3.3.2.3.3). Line managers need to ensure that this interface between the safety analysis report (SAR) hazard level and activity level is addressed. DOE O 440.1A and it's associated guides can be used to assist in addressing activity level hazard analysis and controls.

DOE O 440.1A

EWP

For hazards not identified at a higher level analysis, unique activity-specific controls may be required. The Enhanced Work Planning (EWP) process relies on a work planning team to specify and tailor the controls for this level. At each level (site, facility, activity), these multi-disciplinary teams can address all relevant functional areas or disciplines of concern (e.g., quality assurance, fire protection, chemical safety, industrial safety, radiological protection, emergency preparedness, criticality safety, maintenance). Controls at the activity level may be developed from higher level analysis or by using the results of activity hazard analysis. Emphasis, however, should be on designing the work and/or controls to reduce or eliminate the hazards and to prevent accidents, unplanned releases, and exposures (DEAR 970.5204-2(b)(6)).

1.4 Perform Work within Controls

ISM Guide
Vol 1
Vol 2

In addition to a discussion on authorization agreements, guidance for startup and restart of nuclear facilities is provided in the ISM guide, Chapter II, Section 5. While this process and guidance focus on Category 1 and 2 nuclear facilities, some concepts can be applied directly to chemical hazards at the activity level.

A process to confirm adequate preparation and application of controls prior to authorizing work at the activity level should be carried out by a qualified multi-disciplinary team. First line supervisors should team with employees and safety and health professionals to ensure the activity-level hazards and controls needed to establish a "safety envelope" are in place. The hazard and complexity of work should determine the formality and rigor of the review process, documentation, and level of authority for agreement.

In general, the role of DOE and its contractors with respect to authorizing work and work changes at any level are defined in a properly implemented ISM system. This authorization agreement becomes the binding contractual agreement between DOE and the contractor for predetermined hazardous facilities, tasks, or activities. However, because all activity-level hazards in general cannot be predetermined, activity-based hazards and controls (i.e., chemical hazards) will need to be continually identified.

Beryllium
10 CFR 850

Personal air monitoring for non-radiological chemical exposures is required by one DOE rule, 10 CFR Part 850, *Chronic Beryllium Disease Prevention Program*. If DOE O 440.1A is part of the contract's List B requirements, then application of the Order requires compliance with Title 29 of the CFR which contains substance-specific standards that also require air sampling. In addition, DOE O 440.1A requires exposure monitoring as appropriate for exposure assessments. In any case, good industrial hygiene practice calls for personal air monitoring for any unknown exposure. Applying appropriate statistical analysis to sampling data will allow the industrial hygienist to determine potential employee exposures and the level of controls needed, as well as determine if the operation is in compliance with occupational exposure limits.

Exposure data as part of the hazard analysis and air sampling should be communicated to the occupational medical organization. These data and information on hazards experienced may be used by the first line supervisor to improve the safety of future activities with the same type of exposures.

1.5 Provide Feedback and Continuous Improvement

The expectation for continuous improvement in safety management systems is built into the ISM requirements. After a mission is translated into work and the set of requirements to safely accomplish the work is identified, the contractor and DOE should define the expectation for whether the safety management system is to meet or exceed requirements. This expectation can affect planning, prioritization of tasks, and resource allocation.

Sections (d) and (e) of DEAR, 48 CFR 970.5204.2, require contractors to develop safety performance objectives and measures, and commitments and measure ISMS effectiveness.

Several tool are available to assist managers and provide feedback on chemical management objectives.

CSTC Performance Measures

Occurrence Reports

Employee Concerns Program

- The set of performance measures developed by the Chemical Safety Topical Committee (CSTC), which are provided as examples of useful measures for a site's chemical management program.
- Occurrence Reports and corrective actions for ISMS improvement opportunities.
- Facility environment, safety, and health data and identification of environment, safety, and health issues to develop improvements required in the site ISMS.
- Worker or operator suggestions from the Employee Concerns Program and employee safety organizations.
- Review of DOE program and budget execution and guidance.

Chemical management should be an integral part of the ISM evaluation and annual reporting process. It may be appropriate to include the impact of effective chemical management in performance objectives and measures.

DOE sites and chemical industries with recognized world-class safety programs also use leading environment, safety, and health indicators, such as completed training, attendance at safety meetings, participation in daily or weekly walk-arounds, regulatory compliance, pollution prevention, and waste minimization, to assess the effectiveness of a chemical management system. DOE facilities that actively involve both employees and line management in hazard analyses and self-assessments can develop efficiencies, improve processes and controls, and empower employees to better manage the chemicals under their control.

ACC Responsible Care

DOE Voluntary Protection Program

ISO 14000

Many commercial industries that produce or use large quantities of chemicals are committed to going beyond requirements to ensure safe and effective operations at their facilities. Safety performance records for these companies confirm that a commitment to exceeding safety and environmental requirements results in success. DOE sponsors or supports programs that can result in achieving excellent performance in management systems. Designed for chemical manufacturers, ACC's Responsible Care® Program elements may be adapted for use at DOE sites. The Department's Voluntary Protection Program (VPP) results in safety management systems that compare to the best in industry. International Organization for Standardization (ISO) 14000 can be used to independently validate successful environmental management systems. Any or all of these programs are available to improve the safe management of chemicals at DOE sites.

Team Leaders Handbook

CSTC Lines of Inquiry

In conclusion, the first measure of successful ISM implementation is the verification of the site's program. Guidelines for ISM verification can be found in the ISM Team Leaders Handbook (DOE-HDBK-3027-99). One step in the verification process is to develop Lines of Inquiry (LOI) for specific subject areas. The CSTC has developed a number of LOIs (see Appendix A), which may be used by subject matter experts (SME) to evaluate a site's chemical management program.

2.0 Chemical Management Program

An effective chemical management program has a number of definable elements. First and foremost, the program is part of the site's overall ISMS. However, there are some elements familiar to any manager or safety and health professional that, while not unique to chemical management, should be addressed in terms of the hazards posed by chemical usage.

This chapter addresses ten elements, which can serve as the foundation of a comprehensive chemical management program. However, the breakdown of a chemical management program into any number of elements is an artificial process due to the considerable overlap between elements. By looking at chemical management in a broader sense, one can see that the management of chemicals is a continuum, which begins during the planning of work prior to purchase and continues through the final disposal of the chemical. For example, acquisition of chemicals usually does not consider the disposal of the chemical.

The disposal of chemicals may not be considered part of the chemical management program, but rather is included in the site's environmental management program. However, if pollution prevention is integrated into analyses of chemical management operations, then operators can consider ways to minimize the generation of wastes and prevent pollution and releases for any operation. It is therefore important to ensure good coordination with the site's chemical management staff and the pollution prevention/waste minimization staff.

2.1 Hazard Analysis

All chemicals have the potential to pose a hazard to human or environmental health and safety. Even essential chemicals such as oxygen and water, may cause injury, fatality, or property damage given a specific set of conditions. It is the purpose of the hazard analysis to identify the conditions that can lead to these problems. In addition, the hazard analysis should address the severity of hazards, options for eliminating or substituting less toxic chemicals, assessing the feasibility of controlling the associated hazards, and assessing costs involved in the safe disposal of the chemicals. Ultimately the hazard analysis should lead to the identification of procedures in which chemical substances can be used in a safe, non-polluting manner.

Hazard analysis is a continuous process performed prior to the time a chemical is requested for purchase through final disposal.
As part of a site's overall ISM system, hazard analyses are conducted at the site, facility, activity, and task levels utilizing a variety of resources. The need for this integrated approach is further illustrated by reviewing DOE directives, and OSHA and EPA standards and regulations which call for hazard analysis. At the nuclear facility level, DOE-STD-3009-94, the preparation guide for SARs, requires hazard analysis in Chapter 3, "Hazard and Accident Analyses," and Chapter 8, Section 11, "Occupational Chemical Exposures." At the activity or worker level, DOE O 440.1A and its related Guides (DOE G 440.1-1 and DOE G 440.1-3) requires the identification of workplace hazards and evaluation of risk, and calls out OSHA standards (i.e., 29 CFR 1910 and 29 CFR 1926).

DOE-STD-3009-94

DOE O 440.1A
DOE G 440.1-1
DOE G 440.1-3

Examples of the OSHA standards requiring hazard analyses, either directly or indirectly, include 29 CFR 1910.119 and 29 CFR 1926.64 (Process Safety Management), 29 CFR 1910.120 and 29 CFR 1926.65 [Hazardous Waste Operations and Emergency Response (HAZWOPER)], 29 CFR 1910.1200 and 29 CFR 1926.59 (Hazard Communication), 29 CFR 1910.1450 (Occupational Exposure to Hazardous Chemicals in Laboratories or the "Laboratory Standard"), and various substance specific standards in Subparts Z of 29 CFR 1910 and 29 CFR 1926. EPA also has requirements for performing hazard analyses, such as the Chemical Process Safety Standards (40 CFR 68.67). In addition, Section 313, Emergency Planning and Community Right-to-Know Act (EPCRA) contains hazard assessment requirements. A coordinated approach to meeting these requirements can greatly facilitate the hazard analysis process.

29 CFR 1910.119
1910.120
1910.1200
1910.1450
29 CFR 1926.64
1926.65
1926.59

EPA
40 CFR 68.67
EPCRA

Once a high-level hazard analysis (facility hazard analysis) has been performed, the results can be used in part for meeting other hazard analysis (activity-level) requirements. Sites should use the information from the higher-level hazard analyses when undertaking lower-level analyses.

References to sources of additional information on hazard analysis and exposure assessment are found in the Appendix C, Program Resources.

2.2 Acquisition

Acquisition includes approval, procurement, onsite makeup and mixtures of chemicals, individuals/organizations bringing chemicals onsite, and any other mechanism by which sites acquire chemicals. Acquisition management arranges for the procurement of needed chemicals after work planning, an approved hazard analysis, and life cycle analysis. In other words, effective acquisition management addresses options for eliminating or substituting less toxic chemicals, assessing the feasibility of controlling the associated hazards, and assessing the costs involved in the safe disposal of chemicals. Ultimately, acquisition management should lead to the identification of chemical substances that can be used in a safe, non-polluting manner.

Managers, scientists, and supervisors consider a number of factors during the work planning and acquisition of chemicals, including:

- Need for the chemical;
- Hazards of the chemical;
- Use of non-hazardous or less hazardous substitutes when appropriate;
- Justifiable quantities;
- Use of available excess chemicals in lieu of new purchases;
- Stability/shelf life/legacy hazards;
- Suitability of storage facilities;
- Availability of an appropriate safe and environmentally acceptable means for the final disposition of environmentally sensitive chemicals, products, and by-products;
- Waste minimization and pollution prevention, e.g., use of micro scale vs. macro scale chemistry;
- Required safety documentation [e.g., material safety data sheet (MSDS)]; and
- Input of chemical information into the site chemical management tracking system.

Excess chemicals from within a site's inventory, as well from other sites, should be considered as the primary source of supply. Electronic procurement systems that require a signoff of the site chemical coordinator before an order is filled help control the flow of chemicals onto the site.

DOE Materials Exchange

In addition to site-wide systems, DOE has established the Material Exchange to help facilitate the exchange of chemicals and other materials. The Exchange web site is located at http://wastenot.er.doe.gov/doematex.

Chemical acquisition should be documented in a controlled process that addresses, as appropriate, the identification of: (1) roles and responsibilities of those individuals who are responsible for safely managing chemicals; (2)

those individuals who are authorized to request, approve, and sign for receipt of chemicals; and (3) the individual (usually the requester) and group responsible for a chemical from time of its acquisition to final disposition.

DOE O 440.1A
29 CFR 1910.120
29 CFR 1910.1450
EPCRA Section 313

The following DOE, OSHA, and EPA directives, regulations, and standards pertain to chemical acquisition. At the activity or worker level, DOE O 440.1A requires the identification of workplace hazards and evaluation of risk (440.1A.9). Many standards either directly or indirectly require acquisition management: 29 CFR 1910.120, HAZWOPER, 29 CFR 1910.1200, Hazard Communication, 29 CFR 1910.1450, Laboratory Standard, and EPCRA Section 313.

2.3 Inventory and Tracking

All chemicals brought on site should be tracked. In addition, secondary containers of chemicals which may already be on site should be accounted for. Examples of secondary containers include chemical process tanks, such as electroplating plants and chemical cleaning tanks, which can be the most prevalent source of chemical hazards.

Chemical inventory and tracking systems provide current information on the site's hazardous chemical and material inventories. A properly integrated inventory and tracking system can support other environment, safety, and health requirements (directives). This is a continuous process performed from acquisition, through storage and use, to final disposal.

Several inventory and tracking systems, often using bar code scanners and computer databases, are used throughout the complex. The databases typically include locations, amounts, uses, hazards, and custodians. Regardless of the inventory and tracking software used, it is important to integrate this software with other computerized environment, safety, and health systems, such as Hazard Communication, waste disposal, medical surveillance, and MSDS systems, at a particular site.

DOE O 440.1A

29 CFR 1910.120
29 CFR 1910.1200
29 CFR 1910.1450
EPCRA Section 313

The following DOE directives and OSHA and EPA standards pertain to inventory and tracking. At the activity or worker level, DOE O 440.1A requires the identification of workplace hazards and evaluation of risk (440.1A.9). This Order also calls out OSHA standards included in Title 29 of the CFR. Examples of OSHA and EPA standards which call for inventory and tracking include: 29 CFR 1910.120, HAZWOPER, 29 CFR 1910.1200, Hazard Communication, 29 CFR 1910.1450, Laboratory Standard, and Section 313 (EPCRA).

EH-41 EPCRA Tutorial

The DOE Office of Environmental Policy and Guidance maintains a web site (http://tis.eh.doe.gov/oepa/EPCRA/index.html) which provides an EPCRA tutorial. The first module of this tutorial is entitled, Inventory of Hazardous, Extremely Hazardous, and Toxic Chemicals.

Inventory and Tracking Software

Examples of available inventory and tracking software can be found in Appendix C, Program Resources.

2.4 Transportation

The safe transportation of chemicals includes movement of materials from site to site, from storage to facility, and within a site. A major transportation concern is the potential health and environmental hazards associated with spills resulting from dropping or vehicle accidents.

DOT
49 CFR 172.329

Sites comply with Department of Transportation (DOT) requirements (49 CFR 172.329), as do the suppliers of the chemicals. However, it is good practice to have specific procedures for the internal transportation of materials, which avoid or minimize the potential for spills. These procedures should be properly documented. Transportation also is often tracked in the site chemical inventory systems.

29 CFR1910.120
1910.1200
1910.176
1910.178

In addition, other applicable transportation requirements are found in DOT and OSHA (29 CFR1910.120 (q), 1910.1200, 1910.176, 1910.178) regulations.

Emergency Response Guide Book

Roadside emergencies require quick action such as that found in the 2000 DOT Emergency Response Guide Book. For complete information, contact the shipper. Each shipment requires shipping papers that are placed in the cab of the truck. The shipping paper has an emergency contact phone number. Other emergency information can be found in the Chemical Transportation Emergency Center (CHEMTREC) system.

CHEMTREC

United Nations Placarding

Workers need to understand their roles and responsibilities in responding to a hazardous materials incident. Everyone involved in the transportation function should be familiar with DOT and United Nations placarding, as well as DOT rules for marking, packaging, and describing hazardous materials, and training (49 CFR172). Those involved also need to know the special rules for loading, unloading, driving, and parking a truck with hazardous materials (including 49 CFR 172.329).

49 CFR 172.329

2.5 Storage

Chemical storage includes bulk, tank, piping, cylinder, and container storage of solid, liquid, or gaseous chemicals. Storage regulations apply to new and unused chemicals stored in partially filled containers, chemicals stored in containers other than their original containers, and chemical residues left within tanks, piping, or containers.

The safe storage of hazardous chemicals includes, as appropriate, the following:

- Use of appropriate storage facilities (e.g., flammable storage cabinet for flammable solvents, appropriate distances between reactive chemicals, specialized cabinets for explosive chemicals, and gas cylinder storage sheds and racks);

(Explosives)
29 CFR 1910.109
(Anhyd. Ammonia)
1910.111
(Flammables)
1910.106
(Dip Tank Liq.)
1910.108
(LPG)
1910.110
(Powered Ind.Truck)
1910.178

- Records of quantities and types of chemicals at each storage location;
- Control and documentation of the addition or removal of chemicals from inventory at each location;
- Periodic physical confirmation and validation of inventory records; and
- Documented maintenance and inspection programs that ensure facility integrity.

Section 2.3, Inventory and Tracking

The documentation and periodic confirmation and validation of inventory records can be performed by the chemical inventory system mentioned in Section 2.3, Inventory and Tracking.

2.6 Control of Chemical Hazards

Control of chemical hazards should follow the same hierarchy of controls as any other health and safety hazard, i.e., engineering, administrative, and personal protective equipment. The level and rigor to which chemical hazards are controlled will depend in part on regulatory requirements. For example if the quantity of chemicals on site exceeds TQs, the OSHA and/or EPA process safety standards would apply and a safety analysis may be appropriate. Conversely, for quantities less than the TQs, the OSHA Permissible Exposure Limits (PEL) or American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Values (TLV) would establish the allowable airborne concentrations to which workers may be exposed. In either case, a graded approach should be applied in establishing the controls.

OSHA PEL's

ACGIH

When controls for hazardous chemicals are established, they should be based on the hazard analysis and in conjunction with other controls. Do not duplicate hazard analysis and overlay controls, i.e., if two types of hazard are present which use similar types of controls, the higher level of control should prevail and lead to the control of the lesser hazard.

To ensure control of chemical hazards, management should:

- Cooperate with workers or worker representatives to form chemical safety teams.

- Substitute less hazardous chemicals, when possible.

- Provide ventilation and/or enclosure, as needed.

- Ensure that all chemicals are in appropriate containers with labels and that MSDSs are readily accessible. Title 29 CFR 1910.1200, Hazard Communication, contains important sections about labels and MSDSs, and 29 CFR 1910.1450, Laboratory Standard, also contains a relevant section.

29 CFR 1910.1200

29 CFR 1910.1450

- Provide exposure monitoring, including medical surveillance. Management should establish procedures for monitoring of workers who handle hazardous chemicals. If worker exposure exceeds acceptable DOE or OSHA levels, an investigation should be conducted and corrective actions instituted promptly. Based on the toxicology of the chemicals, exposed workers may need to undergo medical surveillance and periodic examinations.

- Conduct regular training programs, and provide workers with information and instruction on the use and storage of chemicals. Training supports procedural requirements by letting workers know why actions are needed that would otherwise be regarded as inconvenient or unnecessary.

- Inform personnel of the signs and symptoms of control failures.

- Provide and maintain personal protective equipment based on information contained in MSDSs and recommendations of safety and health professionals.

2.7 Pollution Prevention and Waste Minimization

Pollution prevention and waste minimization should be considered during planning, acquisition, use, consumption, excessing, recycling, and waste disposal. If the chemical management program does not cover waste management, some interface and coordination with the site waste management program should be in place.

Pollution prevention is the most responsible and preferred approach to minimizing DOE's impact on the environment and minimizing potential health effects on workers using toxic or hazardous substances or handling wastes, reducing compliance vulnerabilities, and saving money otherwise spent on waste management. Pollution prevention is one of the fundamental principles underlying Environmental Management Systems and, as such, should be part of each DOE site's ISMS. DOE and contractor pollution prevention coordinators should be consulted to assist with tailoring pollution prevention integration to meet program requirements and site needs.

Pollution Prevention Act

The Pollution Prevention Act of 1990 established a hierarchy of preferred practices:

- Prevent or reduce at the source (source reduction);
- Recycle in an environmentally safe manner;
- Treat in an environmentally safe manner; and
- Employ disposal or other release into the environment only as a last resort and conduct in an environmentally safe manner.

November 12, 1999, Memo

In a memorandum dated November 12, 1999, the Secretary of Energy announced a pollution prevention and energy efficiency leadership program with five environmental objectives, including:

- Design and operate DOE facilities using pollution prevention processes that lead to minimal waste generation and lowest life-cycle costs; and
- Diminish use of environmentally harmful materials, equipment, and processes to minimize releases of toxic chemicals, ozone-depleting substances, and greenhouse gases.

The Secretary also directed each Lead Program Secretarial Officer to implement programs to achieve fourteen Pollution Prevention and Energy Efficiency Leadership Goals, including waste and toxic chemical release reductions, as well as increased recycling. Pollution prevention opportunity assessments can be performed to identify the nature and amounts of waste, releases, and energy usage from processes and projects within a site's operations; identify the opportunities for pollution prevention and energy conservation; and evaluate those opportunities for feasible implementation. High return-on-investment projects can be conducted to reduce or eliminate the use of a toxic chemical or the generation of a waste stream.

EO 13148

On April 21, 2000, the President signed Executive Order 13148, *Greening the Government through Leadership in Environmental Management*. This Order calls for Federal agencies to set new goals for reductions in the release and offsite transfer for treatment and disposal of toxic chemicals and for reductions in the use of 15 to-be-determined chemicals. It also requires that agencies review the feasibility of implementing centralized procurement and distribution systems (i.e., pharmacies) that allow facilities to track the acquisition, management, distribution and disposal of materials containing hazardous or toxic substances.

Finally, within the context of chemical management, pollution prevention is often associated with chemical substitution. However, the environmental benefits of pollution prevention should be carefully evaluated to ensure they never override worker safety and health considerations.

2.8 Emergency Management

DOE O 151.1

EH-2 Emergency Management Evaluation Vol. 1 Evaluation Vol. 2

DOE O 151.1 and its related guides establish requirements for Comprehensive Emergency Management Systems. In July 1998, the DOE Office of Independent Oversight found a number of weaknesses in both DOE and contractor Emergency Management programs. These findings indicate that this area should be closely examined in the evaluation of site chemical management programs.

Proper risk assessment, planning, and preparation followed by appropriate and timely response to emergencies is the most effective way to protect the worker, the public, and the environment in case of accidental releases of hazardous substances. Decisions regarding potential exposures should be addressed before an incident occurs. During an emergency, little time exists to resolve such issues or to practice and refine roles and responsibilities. Functions, authorities, and responsibilities for emergency management should be documented and all personnel properly trained. This goal is greatly enhanced by participation in an integrated planning process, including exercising and periodically revising the plan as needed.

DOE sites and facilities need to evaluate preparedness for hazardous materials incidents and plan accordingly, choosing the planning elements and processes most appropriate to their circumstances (i.e., geographic size, types of hazards, populations at risk, resources, and level of preparedness). These elements should be incorporated in a single emergency preparedness and response plan that incorporates and integrates all of the various emergency requirements from DOE directives, as well as federal and state laws and regulations.

DOE O 5500.3A
DOE O 5501.1
DOE O 5501.2
DOE O 5501.3

FEMA SLG 101
NRT 1

(EPA/FEMA/DOT)
FEMA 141

Various explanations of the planning process can be found in the following documents: DOE Orders 5500.3A, 5501.1, .2 and .3; Guide for All-Hazard Emergency Operations Planning [Federal Emergency Management Agency (FEMA) SLG 101); Hazardous Materials Emergency Planning Guide (NRT-1); Technical Guidance for Hazards Analysis (EPA/FEMA/DOT); Handbook of Chemical Hazard Analysis Procedures (FEMA/DOT/EPA); and Emergency Management Guide for Business & Industry (FEMA 141). These documents and planning approaches incorporate the generic functional requirements of planning, although the steps and procedures may be defined somewhat differently.

EPCRA
RCRA

Under EPA (EPCRA and RCRA), certain waste management facilities must comply with preparedness and prevention requirements (e.g., alarm/communications systems, fire control equipment, testing/maintenance of emergency systems, etc.); and must prepare a contingency plan designed to minimize hazards from fires, explosions, or any unplanned release of hazardous waste or constituents. These requirements as well as any additional state and local regulatory requirements and procedures should be integrated with the site's emergency preparedness program.

EH-41 EPCRA Tutorial

The DOE Office of Environmental Policy and Guidance maintains a web site with an EPCRA tutorial (http://tis.eh.doe.gov/oepa/EPCRA/index.html) which is useful in identifying EPA requirements. Modules 2 and 3 cover Emergency Planning Notification and Emergency Releases.

2.9 Disposal

DOE Audit Report (Management of Unneeded Chemicals)

PNNL Cost Savings

Recycling and reuse are cost saving approaches to be considered prior to the disposal of excess chemicals and chemical materials. The cost saving comes from not having to pay for the disposal of the materials and in not having to purchase new chemicals for use in other projects. Researchers at Pacific Northwest National Laboratory (PNNL) achieved a cost savings of $400 ($250 for purchase + $150 disposal costs) for a project when they utilized a chemical mixture no longer needed by other projects.

Chemicals no longer needed to support planned activities should be removed from the facility inventory in an expeditious manner that is documented and in compliance with all applicable regulations. For example, disposition of unneeded chemicals is handled through property management regulations. The final disposition of the chemicals should be recorded, and all applicable records should be transferred to the appropriate personnel.

40 CFR 261.2

Identifying a "waste". A determination should be made as to whether a site's chemicals (materials) meet the regulatory definition of a "waste."

- A waste is any material that is discarded by being abandoned (i.e., disposed of, burned, or incinerated), recycled, or considered inherently waste-like [40 CFR 261.2].
- Certain materials that are "accumulated speculatively" (i.e., accumulated before being recycled) are designated as waste [40 CFR 261.2].
- It is important to recognize that certain materials in inventory (MIN) may meet the regulatory definition of a waste, and thus be subject to waste management requirements. If MIN chemicals are not reused or exchanged, they fall into the waste category and should be dispositioned [per the DOE Office of Environmental Management's (EM) MIN Initiative].

EM MIN Initiative

Hazardous Waste

Identifying a "*hazardous* waste". The generator of a waste is responsible for determining whether waste is a "hazardous waste" subject to regulatory requirements.

- Procedures should ensure that a timely determination is made (by a qualified person).
- Procedures should be based on definitions in RCRA and applicable state law.
- To be classified as "hazardous," a chemical waste must exhibit one or more characteristics of hazardous waste (40 CFR 261.20-24), or be listed as a hazardous waste (40 CFR 261.30-33).
- Note that the listed hazardous wastes include pure and commercial grade formulations of certain *unused* chemicals [i.e., Pure (P) and Unused (U) listed wastes].

40 CFR 261.20, 261.21, 261.22, 261.23, 261.24

40 CFR 261.30, 261.31, 261.32, 261.33

Some requirements for storage of hazardous waste.

- Mark hazardous chemical waste accumulation tanks and containers with the date the waste was placed in the unit, as well as with the words "Hazardous Waste."
- Ensure that the wastes are accumulated in units that are in good condition, stored in areas with adequate ventilation and drainage, and kept closed except to add or remove waste.
- Certain chemical wastes can be accumulated in a "satellite accumulation area" (40 CFR 262.34(c)). Requirements are limited, but must be observed.

40 CFR 262.34

- Generators of hazardous waste are subject to specific quantity and time limits that restrict the amount of waste that may be stored on site at any one time (i.e., without a permit), and the length of time such storage is allowed.

Permitting.

- Facilities that generate hazardous waste are required to obtain a permit.
- Facilities that store hazardous waste for greater than 90 days require a permit.
- Facilities that treat or dispose of hazardous waste generally require a permit.

Requirements for Disposal.

- Hazardous waste must be treated in accordance with the land disposal restriction (LDR) requirements before being disposed.
- LDR treatment standards are established as either constituent concentration levels or specified treatment technologies.

This brief overview cannot identify all regulatory requirements which may apply to a site's waste. However, it is the responsibility of the site to do so.

2.10 Training

29 CFR 1910.132
29 CFR 1926.95
29 CFR 1910.134
29 CFR 1926.103
29 CFR 1910, Subpart Z substance specific standards/
29 CFR 1926, Subpart Z substance specific standards
29 CFR 1910.1200
29 CFR 1926.59
29 CFR 1910.1450
EO 13148

A comprehensive integrated heath and safety training program is a key element in providing a cost-effective means to meet the training requirements for personnel who handle chemicals. The training program must cover all applicable OSHA and DOE requirements for personnel at DOE sites handling chemicals, including workers, supervisors, managers, and visitors. The content and rigor of training should be commensurate with the potential hazards, exposures, worker roles and responsibilities, and requirements. All personnel who may be potentially exposed to hazardous chemicals require hazard communications training.

Training is particularly important for new workers. All workers should be retrained regularly or whenever there is a change in processes or procedures.

Instruction at a minimum should enable employees to:

MSDS

- Identify resources for chemical information.
- Explain information contained on the MSDS and label.
- Locate the MSDS in their area.
- Name hazardous substances in their area.
- Describe the proper handling and storage of chemicals.
- Demonstrate actions necessary to handle chemical spills.
- Describe the proper disposal of chemicals.
- Demonstrate proper use and care of protective equipment.
- Explain emergency and first aid measures.
- Understand pollution prevention requirements.

RCRA

Note: RCRA regulations and permits may require specific training in identifying and handling hazardous waste.

Appendix A

REVIEW CRITERIA AND SAMPLE LINES OF INQUIRY FOR CHEMICAL MANAGEMENT FOCUSING ON CHEMICAL HAZARDS MANAGEMENT

The following provides a collection of lines of inquiry that could be used in an assessment of the chemical management functional area. The lines of inquiry are grouped according to the general criteria for a subject matter expert (SME) evaluation recommended in the Integrated Safety Management System (ISMS) Team Leader's Handbook. These lines of inquiry are suitable for use by a chemical management SME within a broader ISMS review or in a "stand-alone" review of a chemical management program.

The lines of inquiry may be used in reviewing requirements' documentation, interviewing personnel, or observing activities. A robust set of lines of inquiry would enable determination that the given criteria are met.

Members of the Chemical Safety Topical Committee and others with experience in reviews and verifications in this functional area are invited to add to these suggested lines of inquiry, so this collection continues to grow as a valuable resource.

OBJECTIVE

Within the Chemical Management area, the planning of work includes an integrated identification and analysis of hazards, and development and specification of necessary controls. There is an adequate process for the authorization and control of work, and a process for identifying opportunities for feedback and continuous improvement. Within the Chemical Management area, line managers are responsible for safety; clear roles and responsibilities have been established; and there is a satisfactory level of competence.

CRITERIA AND LINES OF INQUIRY

Criterion 1

Procedures and/or mechanisms for activities involving chemicals require adequate planning of individual work items to ensure that hazards are identified and analyzed, and that appropriate controls are identified and selected for subsequent implementation.

Lines of Inquiry

- What is the process used to identify potentially hazardous chemicals that are used or stored in the facility? What hazard analyses are conducted for such chemicals and for chemical processes in the facility? What is the "driver" for these hazard analyses?

- What are the qualifications of personnel performing chemical hazard analysis? Are "hands-on" employees involved in all chemical hazard analyses conducted by SMEs? Do environment, safety and health (ES&H) professionals conduct walk-downs of facilities in which chemicals are to be used or stored, prior to completing the hazard analysis?

- Do the work packages reflect a well-developed planning process that incorporates potential chemical safety concerns?
- Has the facility adequately implemented a job hazard analysis procedure for work planning? Is chemical safety integrated into this process? Is identification (and reduction) of waste generation integrated into this process?
- Are there procedures or instructions in place to specify when review and approval are needed on project documentation to ensure that any chemical hazards management concerns are addressed?
- Does a facility-specific procedure exist to implement a comprehensive chemical hazard management program? Does it reflect site-wide requirements and all applicable standards?
- Are waste types, quantities, and their associated hazards identified in the job hazard analysis and work planning process?
- Are hazards of legacy chemicals (e.g., abandoned, residual chemicals in tanks and pipes with inadequate controls) properly identified and addressed? Have their potentially degraded storage conditions been considered? Have these chemicals been sampled and characterized? Are there adequate controls to prevent and mitigate adverse consequences? Are the containers of these chemicals periodically inspected and maintained? Are the hazards of these chemicals appropriately and sufficiently addressed in the facility's safety basis?
- What is the regulatory status of the legacy chemicals in the facility? Has the regulatory status of the legacy chemicals as hazardous waste been appropriately determined?
- Has pollution prevention (substitution with a non-hazardous material or reduction in quantity used) been considered, when applicable, as a way to prevent or mitigate chemical hazards?
- Are adequate and appropriate controls for chemical hazards identified through the hazard analysis? Are adequate controls identified for all chemical hazards? Are engineered controls preferred over administrative controls? Are administrative controls preferred over personal protective equipment? Are passive controls preferred over active controls?
- Are hazard assessments essential to emergency response established and maintained?

Criterion 2

Procedures and/or mechanisms for the acquisition, storage, use, and disposal of chemicals contain clear roles and responsibilities. Chemical management is effectively integrated with line support managers to ensure that line managers are responsible for chemical management.

Lines of Inquiry

- Are the responsibilities of line management for chemical safety and chemical management clearly defined, documented, and understood?

- Are the roles and responsibilities of support staff and other personnel associated with the facility's chemical management program/system clearly defined, documented, and understood? Have the primary and secondary points of contacts been identified?

- Are the roles and responsibilities of personnel providing chemical safety expertise and support properly integrated with the line management's responsibilities relative to operations?

- Who is responsible for controlling the hazards arising from chemical storage and use in the workplace? How are they held accountable?

- What processes are in place to ensure adequate input by ES&H and other appropriate professionals in the designation of controls for chemical hazards, and in how they are implemented?

- Are the resources needed for providing an adequate level of chemical safety and management support being communicated to the line management? Is management responsive to the resource needs and concerns identified by ES&H and other appropriate professionals?

<u>Criterion 3</u>

Procedures and/or mechanisms for the acquisition, storage, use, and disposal of chemicals require selected <u>controls</u> to be implemented, that those controls are effectively integrated, and that their readiness is confirmed prior to the performance of work.

Lines of Inquiry

- Do facility and warehouse control procedures properly implement chemical management procedures to ensure safe handling and storage of chemicals?

- Is prevention and source reduction of hazardous materials supported by appropriate procurement and inventory practices?

- Is the chemical inventory at a given storage location being properly updated as the inventory changes? Is the inventory inspection and surveillance conducted at an appropriate frequency? Do all chemical storage areas receive adequate coverage through periodic surveillance?

- Is a database or hardcopy file maintained of Material Safety Data Sheets (MSDS) for chemicals used and stored at the work-site and at the facility? How is access to MSDS information provided to workers?

- Is there a procedure that ensures that chemicals stored in a given location are compatible? Is it adequately implemented?

- What criteria are used to select appropriate standards and requirements (e.g., Work Smart Standards, Standards/Requirements Identification Documents, or others, as applicable) to address all chemical hazards? What are the qualifications of individuals performing standards selection?

- What processes are in place to ensure adequate input by ES&H professionals in the implementation of controls for chemical hazards?

- What is the process for authorizing a chemical to be used on the site? What pollution prevention practices are conducted at the site? Is there a list of restricted chemicals? How is chemical storage and use policed? How are excess or waste chemicals disposed of? What processes are in place to assure chemicals are not abandoned when work on a project ceases?

- What means are employed to ensure that the identified controls are implemented, and are operable and functioning so long as a chemical hazard is present?

- Is personal protective equipment required to be used for any activity involving hazardous chemicals? Has substitution of a less hazardous chemical been considered? Are engineering controls in place or planned for these operations? What other controls or measures are in place for these operations?

- When and how is a decision made to evaluate employee exposure to a chemical hazard? What is management's role in assuring that chemical exposures are evaluated and properly addressed?

- How does your occupational medicine group become aware of chemical usage and employee exposure to specific chemicals? What are their roles and responsibilities once an employee's exposure has been demonstrated?

- Are changes to mission, operations, and conditions analyzed for needed changes to requirements? How are ES&H personnel involved in this process?

Criterion 4

Procedures and/or mechanisms for acquisition, storage, use, and disposal of chemicals require that personnel who are assigned to the subject area have a satisfactory level of competence.

Lines of Inquiry

- What training is provided to employees on the hazards of chemicals and chemical processes they work with, and on the controls that are most appropriate for those hazards? How frequently is this training provided? Is this training kept current? What is the frequency of refresher training provided for affected employees? Is training effectiveness measured? If so, how?

- What training is provided to supervisors and managers on management of hazards arising from chemical storage and use?

- Are requests for assistance and documents for information or review distributed to appropriately qualified and knowledgeable staff?

- Are chemical safety support staff sufficiently familiar with facility operations? Do they participate in routine inspections, assessments, and audits; in training; and in the categorization, analysis and development of corrective actions for occurrences? Do they participate in overseeing the implementation of selected controls and in followup inspections of those controls?

- Are the managers, supervisors, and support staff sufficiently knowledgeable about pollution prevention and waste minimization (prevention and source reduction of hazardous materials), such that these are incorporated into their chemical hazard prevention and mitigation activities?

- Does the organization (internal or subcontractor) responsible for providing chemical safety support use a training implementation plan to manage staff training and qualifications?

- Do position descriptions for points-of-contact or coordinators responsible for chemical hazards management appropriately reflect their duties and responsibilities relative to chemical safety, as well as their training and subject matter competency?

<u>Criterion 5</u>

Procedures and/or mechanisms require that <u>feedback</u> and continuous improvement occur with regard to chemical management, chemical safety, and pollution prevention.

Lines of Inquiry

- Has the facility performed an assessment and gap analysis to identify significant gaps and deficiencies in its program? Does the facility maintain its corrective action plan up-to-date? Are the action items prioritized? Have the corrective actions completed been properly closed? Are open items being pursued according to their priority?

- Do post-job critiques and reviews reveal that chemical safety concerns were adequately handled, or if identified, they were adequately pursued and resolved? Is there evidence showing that lessons learned are properly used to improve work conditions or performance?

- Are assessment results communicated to senior management for their use in making informed determinations? Do managers routinely use feedback tools, such as performance indicators, reviews, debriefs, and lessons learned?

- Are occurrence reports evaluated for applicability and communicated to the right individuals?

- Are suggestions of employees and other professionals used to improve performance?

Appendix B

LESSONS LEARNED

The following lessons learned are extracted from DOE Operating Experience (OE) Weekly Summary reports and are included in this Appendix as potential learning and training tools for the reader.

Training. These events underscore the importance for chemical worker training to include hazard information and lessons learned from accidents, previous studies, and similar events involving the same chemicals and chemical work practices

- A chemical tank explosion caused significant localized damage to a facility. Personnel failed to recognize the phenomenon that was being created inside the tank. Concentration by evaporation of a dilute solution of hydroxylamine nitrate and nitric acid occurred to the point where an autocatalytic reaction created a rapid gas evolution that over-pressurized the tank beyond its physical design limitations. Similar hazards were identified as early as 1970, and reports of various accidents were available to the facility. However, these hazards were not included in training and qualification programs to heighten awareness of the chemical hazards. (ORPS Report RL--PHMC-PFP-1997-0023, Final Report 05-17-99)

- An explosion occurred when a chemical operator performing lithium hydride recovery operations submerged a high-efficiency particulate air (HEPA) filter embedded with lithium hydride residue into a salvage vat containing demineralized water. Lithium hydride reacts exothermically with water to form caustic lithium hydroxide and flammable hydrogen gas. The exothermic reaction produced enough heat to begin burning the filter’s wood framing, even though the filter was submerged. Investigators believe that oxygen from air trapped in the filter combined with the hydrogen generated from the reaction caused the explosion. Investigators also determined that it had once been a skill-of-the-craft practice to perforate a filter with holes before cleaning to more efficiently liberate entrapped air and hydrogen during the reaction. This past practice had been lost over time, owing to the attrition of experienced operators, and had not been captured in the procedure for cleaning the filters. (ORPS Report ORO--LMES-Y12NUCLEAR-1999-0031)

- A high-pressure carbon dioxide (CO2) fire suppression system unexpectedly actuated, resulting in one fatality, several life-threatening injuries, and significant risk to the safety of the initial rescuers. Investigators determined the inadvertent operation of electric control heads released CO2 into the occupied space without a discharge warning alarm. In addition, the CO2 system was not physically locked out as was required. The procedure that required this barrier had not been updated or used for this work. The requirement to train workers in the hazards of emergency response to CO2 discharges had not been incorporated into training programs. A contributing cause for the accident was the failure to take corrective actions and apply lessons learned from previous accident investigations, particularly in work planning and control. (ORPS Report ID--LITC-TRA-1998-0010)

- A subcontractor employee was sprayed with acid when he inserted a hydrochloric acid pump into a drum of sulfuric acid. When the two acids mixed, a violent chemical reaction caused acid to be sprayed from the drum approximately 10 feet to the ceiling and onto the employee. (ORPS Report ORO--MK-WSSRAP-1999-0004)

- A technician working in a laboratory discovered a ruptured 1-liter polyethylene bottle of acid on the floor of a chemical hood. Laboratory personnel had heated it to approximately 140 degrees, capped it, and placed it in the hood to cool down. Chemists believe that off-gassing of the acid mixture at an elevated temperature built up sufficient pressure to rupture the bottle. (ORPS Report SR--WSRC-FSD-1998-0004)

- Hazardous waste workers discovered a ruptured 1-liter glass bottle labeled "Used Nitric Acid" in a waste room. Investigators determined that the unvented bottle had accumulated pressure over time, causing it to burst. (ORPS Report CH-BH-BNL-NSLS-1996-0002)

- A building was evacuated due to fumes generated by mixing a solution of nitric acid, hydrogen fluoride, and acetic acid with a solution of ethanol, hydrofluoric acid, and water. Investigators determined that the fumes resulted from a reaction between incompatible materials being mixed for waste disposal by a technician. (ORPS Report SAN--LLNL-LLNL-1997-0037)

- A researcher was adding methanol to two vials containing sodium permanganate and polychlorinated biphenyls when an unexpected energetic reaction caused the mixture to spray from the vials and onto the researcher's gloves. Investigators determined that there was an inadequate evaluation of chemical compatibility. (ORPS Report ORO--ORNL-X10ENVIOSC-1996-0001)

- Personnel who responded to a chemical spill of methyl acrylate were never briefed by facility personnel. As a result, they did not assume command of the event, even though facility procedures require the command to be transferred to Emergency Management and Response (EM&R) if the facility does not have adequate resources to handle an event. The fact that the facility called for the hazardous materials (HAZMAT) team and used the services of occupational medicine was a sign that it did not have the necessary personnel to deal with the event, so EM&R should have assumed the role of incident commander. Furthermore, no one was concerned about the flammability of the chemical. No one called the fire department to respond as a precautionary measure. If the methyl acrylate had ignited, a fire could have quickly spread through the rest of the lab. Also, if a fire had occurred when the spill response team entered the room, they could have been severely burned. (ORPS Report ALO-LA-LANL-TA55-1999-0032)

- During a chlorine leak, the emergency response team was not totally familiar with the facility systems. Plant operators had to tell them how to isolate chlorine cylinders and how to reset alarms to determine if they were still detecting chlorine. (ORPS Report RL--PHMC-S&W-1999- 0002)

- A researcher did not immediately notify his manager or emergency response personnel after a vessel ruptured and expelled a mixture of 130 degrees centigrade trichloroethylene and hydrogen peroxide from the face of a fume hood. (ORPS Report RL--PHMC-PNNLBOPER-1998- 0022)

- Facility personnel waited approximately 30 minutes before reporting a 2-gallon spill of radioactive phosphoric acid. Also, personnel in the spill area did not observe restrictions on eating, drinking, and smoking, and some workers assisted emergency operations personnel without wearing personal protective equipment. (ORPS Report RFO--KHLL-LIQWASTE-1998-0002)

Safe storage of chemicals.

- Students discovered a cylinder containing hydrogen fluoride (HF) that had ruptured inside a storage room next to a laboratory. Following the cylinder failure, investigators learned of a letter DuPont Fluoroproducts sent to its customers two and a half years earlier about the potential over-pressure hazard associated with the long-term storage of Anhydrous HF in carbon steel cylinders. The cylinder was a lecture bottle that had been stored at the university for 22 years. (OE Weekly Summary 99-25)

- Three reactor auxiliary operators were exposed to trimethylamine above the short-term (15-minute) exposure limit while recharging an ion exchange resin in a demineralizer tank. Investigators believe that the excessive off-gassing of trimethylamine resulted from the drums of resin being stored at a higher temperature than that recommended on the MSDS. (ORPS Report ID--LITC-ATR-1998-0014)

- Facility chemists found five sealed containers of lithium metal stored inside a nitrogen glove box instead of an adjacent argon glove box. Lithium reacts with nitrogen and can result in highly exothermic reactions when exposed to water or oxygen. (ORPS Report ID--LITC-ERATOWNFAC-1998).

- A cleaning subcontractor employee became nauseous and vomited while spraying a chemical cleaner in a restroom in the administration building. Investigators determined that the spray bottle was mislabeled "Crew," which is a chemical manufactured for cleaning toilet bowls and sinks. The label did bear the manufacturer’s warnings, but the bottle actually contained nearly full strength Lysol liquid cleaner. (ORPS Report ORO--MK-WSSRAP-1998-0040)

- A maintenance crew discovered a small vial labeled "picric acid" in a crawl space while they were performing a pre-job walk-down for maintenance on some steam lines. Picric acid is normally used as an aqueous solution and an explosive mixture results when the solution crystallizes. Eight similar occurrences involving picric acid were found dating back to 1990. In these events, explosive safety specialists removed the acid and either chemically neutralized it or detonated it in a safe area. (OE Weekly Summary 98-05)

Inadequate control of chemical hazards.

- The Type A investigation of a sodium potassium (NaK) accident that occurred at the Y-12 plant on December 8, 1999, identified a lack of understanding of the hazard from NaK and its reactive by-products as one of the root causes of the accident. The investigation found that personnel involved in planning the task, the safety documentation for the facility, the procedure for the task, and the procedures supporting hazard identification and analysis did not address the complete NaK hazard. The investigation also determined that detailed hazard identification data supported by accident analysis and appropriate control information was readily available.

Appendix C

PROGRAM RESOURCES

Hazard Analysis

DOE G 440.1-3, "Occupational Exposure Assessment"
http://www.explorer.doe.gov:1776/pdfs/doe/doetext/neword/440/g4401-3.pdf

EPA Guidelines for Exposure Assessment (Federal Register Vol. 57. No 104. May 29, 1992)
http://www.epa.gov/ncea/exposure.htm

American Industrial Hygiene Association White Paper On A Generic Exposure Assessment Standard
http://www.aiha.org/papers/exposure.html

National Institutes of Health National Institute of Environmental Health Sciences Chemical Health & Safety Data
http://ntp-server.niehs.nih.gov/Main_Pages/Chem-HS.html

National Institute for Occupational Safety and Health Databases offer online chemical-specific safety, emergency response, and medical surveillance information
http://www.cdc.gov/niosh/database.html

Acquisition

Bechtel Hanford Inc. (BHI), BHI-01248, Chemical Management Plan

Savannah River Site (SRS) Chemical Management Program, AID-AMS-99-0052, September 3, 1999

Inventory and Tracking

The following are a sampling of computerized inventory and tracking systems across the complex:

- Sandia National Laboratory (SNL) Cradle-to-Grave Tracking and Information System (CGTIS)
- Brookhaven National Laboratory (BNL) Standards-Based Management System (SBMS)
- Pacific Northwest National Laboratory (PNNL) SBMS
- Los Alamos National Laboratory Automated Chemical Inventory System (ACIS)
- National Renewable Energy Laboratory Chemical Inventory System (CIS) (modified from PNNL)
- Oak Ridge Hazardous Materials Information System (HMIS)

Transportation

DOT Emergency Response Guidebook (ERG2000)
http://hazmat.dot.gov/gydebook.htm

Storage

Control

Pollution Prevention and Waste Minimization

Applicable pollution prevention regulations/policies and other useful information may be found at DOE's Pollution Prevention Clearinghouse at
http://epic.er.doe.gov/epic/

ChemAlliance Pollution Prevention
http://www.chemalliance.org/RegTools/links/index.asp

Project list for the U.S. EPA - Office of Research and Development
http://www.pprc.org/pprc/rpd/fedfund/epa/epastd/

EPA Waste Minimization National Plan
http://www.epa.gov/epaoswer/hazwaste/minimize/

EPA Waste Minimization Documents
http://www.epa.gov/epaoswer/hazwaste/minimize/p2.htm

Pacific Northwest Pollution Prevention Resource Center
http://www.pprc.org/pprc/

Emergency Management

DOE Pollution Prevention Team (EM-22)
http://twilight.saic.com/wastemin/default/asp

EH-2 Emergency Management Evaluation Vols. 1 and 2
http://tis.eh.doe.gov/iopa/reports/emevals/9808eval/em-vol1.pdf
http://tis.eh.doe.gov/iopa/reports/emevals/9808eval/em-vol2.pdf

The Federal Emergency Management Information System (FEMIS©), developed at PNNL, provides planning, coordination, response, and exercise support for emergency management.
http://www.pnl.gov/femis/

ARAC-3 Modeling System developed at Nevada Test Site is an emergency response system.

http://www-ep.es.llnl.gov/www-ep/atm/ARAC/links.html

National Safety Council (NSC) Emergency Management Resources

http://www.crossroads.nsc.org/emerg_manag.cfm

Computer-Aided Management of Emergency Operations (CAMEO®) helps emergency managers plan for and mitigate chemical accidents and comply with requirements under the Superfund Amendments and Reauthorization Act (SARA) Title III.

http://www.nsc.org/ehc/cameo.htm

Mapping Applications for Response and Planning of Local Operational Tasks (MARPLOT®) allows users to search and display roadways, street addresses, waterways, railroads, census blocks, and other political boundaries.

http://www.nrt.org/nrt/hazmat2000/hazmat2000.nsf/pages/625.html

Agency for Toxic Substances and Disease Registry's (ATSDR) Hazardous Substance Release/Health Effects Database provides access to information on the release of hazardous substances from Superfund sites or from emergency events and on the effects of hazardous substances on the health of human populations.

http://www.atsdr.cdc.gov/hazdat.html

CHEMTREC is a source for hazardous materials/dangerous goods information and communication.

http://www.cmahq.com/cmawebsite.nsf/pages/chemtrec

NSC Environmental Health Center provides emergency response information on specific chemicals as well as additional links.

http://www.nsc.org/ehc/chemical.htm

Risk Management Plans (RMP) from Right to Know Environmental Databases - Under the Clean Air Act Amendments of 1990, certain chemical facilities must report RMPs to prevent and respond to chemical accidents in the United States.

http://www.rtk.net/aboutrmp.html

RMP*InfoTM - displays Risk Management Plans submitted by facilities under Section 112(r) of the Clean Air Act that include information about Risk Management Programs implemented to prevent and prepare for chemical accidents.

http://www.epa.gov:9966/srmpdcd/owa/overview$.startup

Disposal

RCRA Orientation for Facility Managers (Computer Automated Guidance), Version 1.0, September 1998. (See "Training")

http://tis.eh.doe.gov/oepa

Definitions of Solid and Hazardous Wastes (Computer Automated Guidance), Version 1.0, April 1997. (See "Tools")
http://tis.eh.doe.gov/oepa

RCRA Guidance Manuals (See "Policy & Guidance")
http://tis.eh.doe.gov/oepa

RCRA and Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Information Office of Environmental Policy and Guidance Publications List - RCRA/CERCLA Division (EH-413)
http://tis.eh.doe.gov/oepa/guidance/publist.pdf

EPA Office of Solid Waste Materials
http://www.epa.gov/epaoswer/osw/publicat.htm

Identifying Your Waste: The Starting Point, EPA530-F-97-029, September 1997.
http://www.epa.gov/epaoswer/osw/mbodyi.htm

RCRA Orientation Manual, EPA530-R-98-004, May 1998.
http://www.epa.gov/ncepihom/Catalog/EPA530R98004.html

Training

OSHA 2254, "Training Requirements in OSHA Standards and Training Guidelines" (revised 1995)
http://www.osha-slc.gov/Publications/osha2254.pdf
Addendum
http://www.osha-slc.gov/Publications/2254addendum.pdf

Voluntary Training Guidelines; Issuance of Revised Training Guidelines - 49:30290
http://www.osha-slc.gov/FedReg_osha_data/FED19840727.html

Training Requirements in OSHA Construction Industry Standards and Training Guidelines
http://www.osha-slc.gov/doc/outreachtraining/htmlfiles/osha2254.html

DOE National Environmental Training Office (NETO) Training on Pollution Prevention Opportunity Assessment
http://www.em.doe.gov/neto/index.html

CONCLUDING MATERIAL

Review Activity:		**Preparing Activity:**
DOE	Field Offices	DOE-EH-52
		Project Number:
		SAFT-0073

National Laboratories

Area Offices

This draft, August 2000, prepared by the Office of Worker Protection Policy and Programs, has not been approved and is subject to modification. Project No. SAFT 0073

TS

NOT MEASUREMENT SENSITIVE

DOE-HDBK-XXXX/2-2000
PROPOSED

DOE HANDBOOK

SITE APPROACHES TO CHEMICAL MANAGEMENT

(Volume 2 of 2)

U.S. Department of Energy
Washington, D.C. 20585

AREA SAFT

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Table of Contents

1.0 Argonne National Laboratory (ANL)

Inventory and Tracking

Inventory and Tracking

The Chemical Management System (CMS) serves as an umbrella to both the MSDS System and the Chemical Tracking System (CTS). The CMS provides a single source for delivery of MSDSs as well as chemical inventory data site-wide. The system also contains special features and reports designed to assist the Laboratory with its goals for Waste Minimization.

Chemical Tracking System

1. Initial Inventory. Collection of initial inventories was at the 80% completion mark in Spring 2000, with only a few divisions remaining without bar-coded inventories.

The CTS ordering process provides assigned barcodes to chemicals when they arrive at the Receiving Dock. Interfaces have been established with the procurement system and most recently with the new electronic AMOS system. These links allow chemical inventory records to be created at the time the order is received with data transferred to the CTS directly from the procurement systems. This eliminates the extra step of entering data into the CMS. The receiving personnel then assign barcode labels and send them along with the chemical package. Future plans include linking chemicals in the AMOS catalog with their assigned ANL MSDS numbers.

2. Periodic Inventory Reconciliation. Divisions which maintain their inventories and delete chemicals on a continual basis throughout the year should conduct an inventory reconciliation at least once every three years. Divisions with high volume chemical usage and those which may not keep up with deletions may need to reconcile their inventory once every year in order to keep records reasonably accurate. With barcodes on all ANL chemicals, the inventory verification process is done quickly with the use of scanners. Three divisions conducted inventory reconciliations last summer. The Environment, Safety and Health Division (ESH) has four scanners available on loan for this activity.

3. Bulk Chemical Module. A bulk chemical module, also known as Controlled Quantity Chemicals (CQC), is used to track usage of chemicals in storage tanks, where barcoding is not appropriate. This module keeps a running total of current quantities, quantity received, and total usage for the year. It eliminates the need for manual tracking and paperwork, while providing data required for regulatory reports, such as Superfund Amendments and Reauthorization Act (SARA) chemicals.

4. Hazardous Chemicals Reporting Module. A reporting module has been established to meet the needs of users, ESH, and Emergency Management Organization (EMO) personnel for reporting on certain categories of hazardous materials on site. Reports completed thus far include a Carcinogen Report, Expiration-Dated Chemicals Report, and a SARA Report. In addition, items with an expiration date as specified in the ESH Manual will automatically be set with an expiration date on their inventory records as they are received on site, alleviating the need for the user to set this flag.

Pollution Prevention and Waste Minimization

Waste Minimization

1. Surplus Chemical Flag. A surplus chemical flag can be activated for any chemical in CTS. Items, particularly unopened items, that users can make available to others are marked as "Surplus" in the inventory. CTS allows users to check the Chemical Bulletin Board on the system for items marked as surplus, and allows for transferring and acceptance of chemicals from one another.

2. Chemical Bulletin Board. The CTS Chemical Bulletin Board is now also available prior to entering the ordering system. This provides an opportunity to check for surplus chemicals prior to placing a new order. If there is an item of interest, the Surplus Chemical Bulletin Board provides ownership information as well as detailed information about the chemical.

3. Packing Slip - Regulated Chemicals Notification. In the near future, the packing slip that is received from CTS, indicating the chemicals received and corresponding barcode labels, will also contain a regulated chemical notification after each item. Categories of regulated chemicals to be tracked include Carcinogens, Expiration-Dated, Toxic Release Inventory (TRI), and SARA chemicals. A quarterly report of the total amounts of each category of regulated chemicals received is sent to the divisions.

MSDS System

The MSDS System provides a central collection of documents for materials purchased at both ANL-East and ANL-West. The system now contains over 20,000 documents. Due to both liability issues and determining which manufacturer's MSDS to maintain, it was decided that it is more feasible and more efficient to maintain each manufacturer's MSDS.

The CTS includes the following items:

- In general, all hazardous chemicals and chemical products on site shall be bar-coded and tracked in the CTS (OSHA definition 29 CFR 1910.1200 and 1910.1450).
- For new orders, barcodes will be assigned automatically as the containers are received.

- Bulk chemicals delivered to storage tanks shall be tracked as CQCs, using the CTS Bulk Chemical Module. Chemicals stored in drums may be tracked in the same manner.
- Oil products (e.g., vacuum pump oil, drums of lubricating or dielectric oil) shall be tracked, either by bar-coding or using the Bulk Chemical Module.
- Lecture bottles and gas cylinders other than Compressed Gas Association (CGA) gas cylinders shall be tracked. Beryllium compounds, pure beryllium blocks, and alloys which may be machined or abraded need to be tracked.

The CTS may exclude the following items:

- An article is a manufactured item that is formed to a specific shape or design, has an end use function dependent on its shape or design, and will not release a hazardous chemical under normal conditions of use.
- Any consumer products used in the workplace in the same manner as normal consumer use, and which use results in duration and frequency of exposure that is not greater than the occasional exposures experienced by consumers do not need to be tracked. (e.g., Windex, BonAmi)
- Office products are to be handled in the same manner as consumer products. (e.g., white-out, copier toner). However, a current MSDS for these items needs to be provided for the ANL MSDS system.
- Chemicals, which are transferred from original containers to other containers for purposes of dilution, need not be tracked separately.
- Analytical standards may be excluded when the concentration of a non-carcinogenic material is < 1.0%.
- Analytical standards which are carcinogens may be excluded when the concentration is < 0.1%.
- pH buffer standards, pH 4-10, may be excluded.
- Special materials, CGA gas cylinders, and sealed sources are being tracked in separate database systems until this information can be effectively integrated into the Chemical Management System.
- Beryllium may be excluded as finished articles, which will not be abraded, such as crucibles, springs, and x-ray windows.
- Certain biological chemicals and supplies may be excluded if the hazard level, as defined by knowledgeable technical staff, is clearly less than that defined for any regulatory category of hazardous chemicals AND the chemical is used in small quantities (< 1 kilogram or < 1 liter) in a research laboratory.

Process for Exclusion of Specific Chemicals: The research scientist should consult his divisional ESH Coordinator and Chemical Hygiene Officer to prepare a list of proposed items for exclusion from tracking for his research laboratory.

2.0 Bechtel Hanford Inc. (BHI) CMP Plan (BHI-01248)

The Hanford Site prime contractors originally established the Hanford Chemical Management Program (CMP) Requirements (Requirements) as a voluntary joint commitment in November 1997. These Requirements were revised in November 1999. When the original CMP Requirements were signed in November 1997, BHI had a program for the management of chemicals already implemented into its work flow process. However, to be certain BHI had included all elements of the Requirements document in its operations, BHI performed an assessment of its work control system to determine compliance with the prescribed criteria and the extent of any chemical vulnerability in its operations. As part of this assessment, BHI conducted a gap analysis that compared current BHI work control program activities to the applicable criteria of the CMP Requirements. Although opportunities for improvement were noted, the overall conclusion was that significant risks to workers, the public, and the environment from chemicals under BHI control were being adequately addressed by the existing project work control system. However, realizing the opportunity for improvement existed, several actions were implemented to improve the BHI program. These included the following:

- Drafting and/or modifying existing BHI procedures to incorporate the newly implemented Requirements into its operations
- Upgrading the BHI chemical tracking system
- Identifying CMP performance measures
- Providing for an annual management review of CMP Requirements by the Department of Energy (DOE).

Additionally, existing BHI procedures were evaluated to assess compliance with the requirement that the CMP be fully integrated with the principles of the Integrated Safety Management System Document (ISMSD) (#BHI-01199). The ISMSD focuses on BHI's primary methods for integrating environment, safety, and health considerations into the Environmental Restoration (ER) Project work processes, at all levels, including the Core Functions (CFs) and Guiding Principles (GPs) for those processes. BHI compliance with the full integration of the CMP program and the ISMS was demonstrated (provided in Table 1).

Table 1. Analysis of ISMS Policy Compliance.

ISMS Elements	ERC CMS Elements	ERC Procedures
Define scope of work	1. ***Identify requirement for chemical*** 2. Waste minimization	1. BHI-DE-01, *Design Engineering Procedures Manual* 2. BHI-MA-02, *ERC Project Procedures,* 9.1, "Waste Management Program"
Identify and analyze hazard	3. Hazards analysis • MSDS • Activity hazard analysis • SS HASP	3. BHI-SH-02, *Safety and Health Procedures,* 1.7, "Project/Facility Safety Planning and Documentation;" BHI-SH-02, 1.3, "Hazards Communication"
Develop and implement controls	4. Procurement and subcontract controls 5. Chemical hazard training 6. Work planning 7. Emergency planning 8. Chemical tracking/reporting	4. BHI-PR-01, *ERC Procurement Procedures* 5. BHI-SH-02, 1.3, "Hazards Communication" 6. BHI-SH-02, 1.7, "Project/Facility Safety Planning and Documentation" 7. BHI-SH-03, Vol. 1 *Emergency Management Program* 8. BHI-EE-02, *Environmental Requirements*
Perform work	9. Supervision 10. Waste Management	9. BHI-FS-01, *Field Support Administration*, 2.1, "Work Control" 10. BHI-EE-10, *Waste Management,* & Chemical Vulnerability Studies.
Feedback/improvement	11. Assessments 12. Lessons learned	11. BHI-MA-02, 2.9, "Surveillances" 12. BHI-MA-02, 2.5, "Lessons Learned"

Scope

The scope of the BHI CMP applies to all chemical management operations associated with the acquisition, storage, use, tracking, transportation, and final disposition of chemicals and products containing chemicals under the control of BHI at the Hanford Site. A chemical is defined as any substance or product that requires a Material Safety Data Sheet (MSDS) and is regulated under the Occupational Safety and Health Administration (OSHA) Hazard Communication Standard, 29 CFR 1910.1200 and Appendices A and B. Hazardous waste is not covered within the scope of the BHI CMP Plan as it is exempted by definition in regulations that implement OSHA. Similarly, any hazardous substance defined and regulated under the *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (CERCLA) as part of a remedial or removal action is not covered. However, the CMP plan provides for interface with these waste management and remedial action systems if product chemicals should become part of the waste streams managed by BHI.

Primary Roles And Responsibilities Of BHI Personnel Responsible For The CMP Plan

While the BHI Environmental Technology Manager is responsible for the overall administration, management, and maintenance of the BHI CMP, other members of the Project Team who have primary responsibilities within the CMP include the following:

- Senior Management
- Site Supervisor
- Facility Superintendent
- Project Engineer
- Field Analytical Services
- Safety, Heath, and Radiation Control
- Waste Management personnel
- Procurement and subcontracts
- Regulatory Support
- Compliance and Quality Programs
- Emergency Preparedness.

Responsibilities of the Project Team members are presented in Appendix 1 of the CMP, which is a logic diagram (work flow process) that depicts the associated interfaces between BHI team members.

Key Elements Of The BHI CMP

Acquisition

Acquisition

Acquisition of chemicals includes procurement, onsite makeup of chemical mixtures, subcontractor-acquired chemicals, and any other means by which chemicals are acquired or brought onto the Hanford Site. BHI procurement purchases chemicals through the following four methods:

- Field Material Requisition (FMR)
- Purchase Card (P-Card)
- Blanket Purchase Agreements (BPA)
- Transfers from other Environmental Restoration Contractor (ERC) locations or DOE contractors.

Storage

Storage

Storage of chemicals includes storage of solid, liquid, and/or gaseous chemicals. Chemicals may be stored in office buildings, the central warehouse, or at the job site. Proper storage of chemicals at project sites is required. A listing of each chemicals' MSDS sheet must be available in the general area where the chemical is kept.

Use

Use of hazardous chemicals is addressed by hazards analysis either generically (i.e., for store stock items) or as part of a hazardous chemical process. The use of engineering controls, administrative controls, and personal protective requirements shall be applied, as appropriate. These responsibilities are defined in the BHI hazards assessment and hazard communication programs. The hazard assessment for the use and storage of chemicals occurs first in the conceptual design stage of the ISMS, then during the development of the work package, and again before purchasing the materials.

Inventory and Tracking

Tracking

The Chemical Inventory Database (CID), an ACCESS database program, is currently used by BHI to track chemicals at the BHI work locations at the Hanford Site. This system is updated, at a minimum, on a quarterly basis and includes, but is not limited to, the following information:

- Locations where chemicals are stored
- Quantity of chemicals stored at each location
- Type of chemicals stored at each location
- Emergency Planning and Community Right-to-Know Act (EPCRA) threshold quantities for each chemical
- MSDSs for BHI chemicals
- Chemical custodians.

Reports from this database are used for reporting requirements under EPCRA, OSHA, and for emergency response planning activities. Chemicals that have been designated as waste leave the CID system and are entered into the Solid Waste Information Tracking System (SWITS).

Transportation

Transportation

Transportation includes all movement of chemicals subject to the U.S. Department of Transportation (DOT) or Hanford Site transportation requirements. The shipping and transportation of chemicals by BHI is handled primarily as a joint effort between BHI Waste Management personnel and the union workers. Waste Management personnel classify, package, mark, label, placard, and prepare shipping papers for the onsite transportation of chemicals. Once the shipment is ready for transportation, the union workers are notified to pick up the shipment. Union workers receive all necessary training to be qualified for transporting chemicals under DOT regulations.

Disposal

Final Disposition

The effective management of chemicals encompasses a "cradle to grave" approach. Chemicals not needed to support planned activities will be dispositioned for removal from the facility inventory in an expeditious manner that is documented and compliant with all applicable regulations. Chemicals removed should be considered for excessing and recycling before being designated as waste. The final disposition of the chemicals is recorded in the CID and all applicable paperwork is transferred to the appropriate personnel.

Subcontractor Requirements

BHI CMP requirements are passed to its subcontractors through Exhibits A and G of the subcontract. These Exhibits require the subcontractor to comply with the following requirements:

- Before start of work, subcontractor employees shall receive hazard communication training per OSHA regulations at 29 CFR 1910.1200 (h) or 29 CFR 1926.59(g).

- The subcontractor shall submit to the contractor, an inventory of hazardous materials (including product name, quantity, and date of inventory) when entering AND leaving the Hanford Site. If the duration of the subcontract exceeds 3 months, the subcontractor shall resubmit an updated inventory every 3 months for the duration of the subcontract.

Functional Integration Support

Consistent with the Integrated Safety Management System (ISMS), effective implementation of the BHI CMP requires integration with key functions to include, but not limited to, the following:

- Procurement and Property Management
- Safety and Health
  - Chemical safety
  - Laboratory safety
  - Industrial hygiene
  - Occupational medicine
  - Hazard communication
- Fire protection
- MSDS system
- Emergency preparedness and response planning
- Emergency responders
- Transportation
- Quality assurance
- Environmental Technologies
- Field Support/Waste Management.

Training

Training

BHI has specific training requirements for all employees who may be involved with the management of chemicals. All onsite temporary, part-time, or full-time employees must have Hanford General Employee Training (HGET) within 7 days of employment at BHI and annually thereafter. All BHI employees also received training on the ISMS requirements. Employees who work in the presence of any hazardous materials or chemicals shall be trained at the time of their initial assignment and whenever a new hazard is introduced into their work area.

3.0 Idaho National Engineering and Environmental Laboratory (INEEL)

Storage

Storage

Chemical storage at the INEEL is based on requirements from OSHA, the National Fire Protection Association (NFPA), and other agencies. INEEL documents consolidate duplicate requirements, resolve inconsistencies or conflicts between requirements, and provide interpretations when necessary. These consolidated requirements are implemented through programs and procedures and employees are trained on those programs and procedures to ensure proper implementation. In the area of chemical storage, there are four major groups of requirements that need to be implemented: (1) tracking chemicals for inventory/reporting purposes; (2) ensuring that chemicals are stored compatibly; (3) ensuring that facility storage limits are not violated; and (4) managing time sensitive chemicals. Since these four areas can become rather complex from both a regulatory and technical point, tools had to be developed to help the worker implement chemical management programs and procedures.

Two primary tools that have been developed are the INEEL chemical management system (ICMS) and the chemical data summary page that is part of the ICMS. The ICMS is a chemical inventory tracking and reporting database and the summary page is a compilation of site-specific information concerning the chemical. This chemical data summary page is meant to augment each chemical's MSDS – not replace them. Information present on the summary page includes:

- What a secondary container label should look like for that chemical;
- What hazards are associated with the chemical;
- How the chemical is classified according to the company's compatible storage system;
- Whether or not the chemical is time sensitive, and, if so, what hazard will be developed upon prolonged storage; and
- How the chemical is classified according to the Uniform Building Code/Uniform Fire Code (UBC/UFC).

When a user receives a chemical, they can consult the summary page to determine the compatibility grouping that the chemical falls in which will then tell them how they should store the chemical to ensure compatible storage conditions. Since information in the summary page is linked to the ICMS, users can print reports that tell them whether or not they are in compliance with UBC/UFC facility limits for their chemicals. Time sensitive chemicals are managed by first identifying them in the chemical data summary page. Once identified, ICMS can track time sensitive chemicals and alert users that a chemical is approaching its expiration date.

4.0 Oak Ridge National Laboratory (ORNL)

Emergency Management

Emergency Management

(need concise 'approach' writeup and url to "Example Emergency Management Program Elements from the Oak Ridge National Laboratory")

5.0 Pacific Northwest National Laboratory (PNNL)

Acquisition

Acquisition

Chemical acquisition, inventory, and tracking is governed under PNNL's Standards-Based Management System (SBMS). Requirements for standard and non-standard types of chemical acquisition are covered under the "Working with Chemical" subject area of SBMS at http://sbms.pnl.gov/standard/03/0302d010.htm. The first alternative in procuring chemicals is to look within PNNL for existing stocks of the chemical that will satisfy the research needs. PNNL has a "Pop-Chem" tool on the same personal computer utility as site telephone numbers that searches chemical inventory information to find where a specific chemical is located by name or Chemical Abstract Service (CAS) number. It provides the quantity, owner, and a phone number for each chemical container.

Inventory and Tracking

Inventory and Tracking

The standard procurement methods are linked to PNNL's Chemical Management System© (CMS) inventory and tracking database tool, and the procurement establishes the inventory record which is linked by bar-code on arrival. CMS is an Oracle database application. The use of CMS is discussed in the "Chemical Management System" subject area of SBMS at http://sbms.pnl.gov/standard/1h/1h00t010.htm.

Storage

Storage

(need 'approach' writeup) Additional information on PNNL chemical storage practices is found on PNNL's Standards-Based Management System (SBMS) web site at http://www.sbms.pnl.gov.

Pollution Prevention and Waste Minimization

Waste Minimization and Pollution Prevention

(need concise 'approach' writeup) Comprehensive information on PNNL's pollution prevention program is available at ***(need url)***.

Training

Training

PNNL's chemical safety training philosophy is the same as for other hazardous work. Employees must be trained before conducting the work or working in spaces where a hazard is present. Training is composed of general and job-specific training.

Under the Integrated Operations System (IOPS), supervisors access online tools to review training of staff members to ensure it is up to date. In addition, periodic training reports indicate if there are training deficiencies against a predetermined set of training requirements tailored to each individual at PNNL.

Additional information on PNNL's Training/Awareness for Use of Hazardous Chemicals Program is available at http://sbms.pnl.gov/standard/03/0306d010.htm

6.0 Savannah River Site (SRS)

Hazard Analysis

Hazard Analysis

Chemical hazard analysis at the Savannah River Site (SRS) follows the ISMS approach. Chemicals are identified during the initial stages of the facility design Process Hazard Review (PHR) for new and upgraded facilities. CERCLA, OSHA's Process Safety Management (29 CFR 1910.119), and EPA's Risk Management Programs (40 CFR 302.4) are used as references for the PHR. SRS has a site-level procedure for the generation, review, and approval of safety documentation for buildings that include all three levels of chemical hazard: high hazard (facility below radiological thresholds, but above chemical thresholds); low hazard facility (below radiological or chemical thresholds, and at or above the Reportable Quantities); and other facilities below all thresholds.

Engineering controls, administrative controls, and facility-specific chemical safety training are developed and implemented to mitigate the chemical hazards present. SRS conducts emergency preparedness drills and exercises to verify that proper controls and response procedures are in place. Existing facilities use operating experience, lessons learned, periodic PHRs, Job Hazards Analysis, and feedback from drills and exercises to analyze for chemical hazards that may have changed. Any change in hazard results in new analysis and possibly new controls. SRS is very sensitive to new information on chemical hazards and, as part of the overall chemical management program, has a process to alert the site to new hazards and implement proper controls to mitigate the newly identified hazards.

Acquisition

Acquisition

The Chemical Commodity Management Center (CCMC) is the only site organization authorized to approve the purchase of chemicals and chemical products. Chemical request forms sent to the CCMC undergo a review to ensure the following:

- The chemical or chemical product is not currently a stocked item;
- The chemical is not available through the site Excess Chemical Management Program;
- The site MSDS system has a current MSDS; and
- The chemical does not pose an unreasonable risk to workers or the environment.

Once the review is complete, the CCMC buyers place the orders using existing just-in-time (JIT) contracts as much as possible. This expedient process has reduced the amount of chemical products warehoused and the cost associated with their warehousing. The Operating and Support organizations have reduced the need to store chemical products as they see the improved service provided by the CCMC chemical buyers. With fewer chemical products in these organizations, the risk of employee exposure to the chemicals decreases, as does the risk of a chemical release. The total amount of chemicals stored at SRS has been reduced 52% over the last four years.

Inventory and Tracking

Inventory and Tracking

The Westinghouse Savannah River Company (WSRC) site-wide chemical inventory is maintained in a controlled database. Access to this database is granted to members of the CCMC and site Chemical Coordinators (CC). The CCs are required to update their chemical inventories monthly. Westinghouse Safety Management Solutions (WSMS) uses this inventory to identify chemicals regulated under the EPA Risk Management Plan (RMP). This inventory also alerts the facility manager if an inventory of a regulated chemical approaches the RMP threshold limit. (WSMS is a spin-off company of WSRC with extensive knowledge and skill in developing safety documentation.)

Storage

Storage

Safe chemical storage practices at SRS follow the guidance provided in section 7-1 of the site WSRC 3B Asset Management Manual. Storage practices are consistent with site and facility-specific procedures relating to fire protection, industrial hygiene, and waste minimization, and guidelines available from technical references including information provided in the MSDSs. Chemicals are broadly categorized into specific groups for storage based on their physical and chemical characteristics. Pure chemicals (identifiable by a unique CAS number) are placed into certain classes/groups that possess similar chemical properties/characteristics, such as acids, bases, toxic chemicals (carcinogens, asphyxiants, corrosives, poisons/toxins, etc.), oxidizers, reducing agents, combustible materials (of which flammable liquids and combustible liquids form subsets), non-combustibles, water-reactives, air-reactives, pyrophorics, self-reactives, explosives, shock-sensitives, peroxides and peroxide-forming chemicals, light (or photo)-sensitive materials, etc.

Significant quantities of chemicals used at SRS are in the form of commercial products, such as construction coatings, paints, sealants, cleaners, oils and greases, etc. These are usually mixtures of pure chemicals. By examining technical information from the MSDS (e.g., physical property and chemical composition data, hazard ratings, storage and handling, incompatibilities, reactivity, etc.), and by assuming the product (mixture) to exhibit chemical properties of the dominant constituents, SRS assigns commercial products to approximate chemical categories. Most often, non-aqueous systems containing hydrocarbons fall into the flammable or combustible category while inorganic aqueous systems turn out to be non-combustible.

Chemicals at SRS are stored based on chemical compatibility considerations, with a “safe” distance of physical separation maintained between incompatible chemical classes. The “safe” distance is often arrived at as a result of experience and professional judgment using information from the MSDSs and other chemical literature, but in some instances, the distance is prescribed by fire protection considerations [e.g., via NFPA codes and the site Fire Protection Manual, WSRC 2Q). Labels are used to indicate pre-designated storage areas for incoming chemical shipments. In addition, Site Fire Protection provides input on fire safety aspects of the facility via periodic inspections.

Training

Training

Chemical training at SRS has been developed using regulatory and best management practices. All new site employees receive initial OSHA Hazard Communication (HazCom) training during General Employee Training (GET). Every two years thereafter, all employees receive HazCom refresher training during required Consolidated Annual Training (CAT). Employees receive additional HazCom training depending on their job classification. Workers at Research and Development Laboratories fall under 29 CFR 1910.1450 and receive annual Chemical Hygiene Plan/Lab Standard refresher training. Chemical workers, as defined in 29 CFR 1910.1200, initially receive basic and facility-specific HazCom training. The facility-specific training is refreshed every two years or upon the introduction of a new chemical hazard into the facility.

Each operating procedure begins with a Scope section followed by a section devoted to Safety. Employees are trained to carefully review this section for potential chemical hazards. The HazCom training informs employees of the basic types of chemical hazards. The training also shows the employee how to read a MSDS in order to find the specific hazards of each chemical or chemical product. Scanned images of all site-approved MSDSs are available to employees through the SRS intranet.

For infrequent jobs, employees are trained to use the ISMS. The job scope is defined and the hazards are identified during a required Work Clearance Permit and/or Job Hazards Analysis. These hazards are reviewed and controls are developed and implemented. After the work has been performed safely, feedback can be provided through management to complete the ISMS circle.

CONCLUDING MATERIAL

Review Activity:

DOE

Field Offices

National Laboratories

Area Offices

Preparing Activity:

DOE-EH-52

Project Number:

SAFT-0073